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(54) Automotive Air-Conditioning Apparatus

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Specification

1. Invention Title

Automotive Air-Conditioning Apparatus

2. What is claimed is:

An automotive air-conditioning apparatus in which a temperature control dumper adjusts the ratio in a flow rate of chilled air which is chilled by an evaporator in a

refrigerating cycle device and heated air which is heated by a heater core, thereby controlling the temperature of blowing air, wherein an auxiliary chiller is inserted between a condenser and a pressure reduction device and at the same time, the auxiliary chiller is located upstream of said heater core in an air duct system for air-conditioning.

3. Detailed Explanation of the Invention

The present invention relates to an automotive air-conditioning apparatus.

Conventionally, an automotive air-conditioning apparatus obtains a cooling function using a refrigerating cycle device, which comprises a compressor, a condenser, a liquid reservoir, a pressure reduction device and an evaporator. The liquid reservoir, however, contains a vapor liquid interface of a chilling medium within it and therefore a chilling medium liquid is almost in a saturated state at an outlet of the liquid reservoir and a sufficient volume of a super cooled liquid can not be obtained. This is a cause which inhibits improvements in cooling capacity.

Furthermore, some air-conditioning apparatuses are known which employ a refrigerating cycle device in which a liquid reservoir is eliminated and instead an accumulator is provided at an inlet side of a condenser. In this case, an insufficient capacity of the condenser inhibits cooling capacity.

In view of above, the present invention aims to efficiently improve cooling capacity by performing cooling with an auxiliary chiller provided between a condenser and a pressure reduction device while placing the auxiliary chiller upstream of a heater core in an air duct system.

The present invention is explained below using examples shown in figures. In Figure 1, a compressor 1 was designed to be activated by an automobile engine (not shown in the figure) through an electromagnetic clutch 2, and on its outlet side a condenser 4 was provided which was connected through a pipe 3. An outlet of condenser 4 was connected to a liquid reservoir 6 through a pipe 5. Liquid reservoir 6 was equipped with an outlet pipe 6a, which opened inside the reservoir near the bottom, and this outlet pipe 6a was connected to an auxiliary chiller 8 through a pipe 7. This auxiliary chiller 8 can have the same constitution as that of condenser 4. For example, it can have a constitution of a combination of a flat tube and corrugated fins. An outlet of auxiliary

chiller 8 was connected through a pipe 9 to a temperature activated expansion valve 10 which made up a pressure reduction system, and expansion valve 10 was connected to an evaporator 12 through pipe 11. An outlet of evaporator 12 was connected to an inlet side of compressor 1 through a pipe 13. In the present example, all of the above components 1 ~ 13 made up a refrigerating cycle device for automotive air-conditioning. Moreover, compressor 1, condenser 4 and liquid reservoir 6 were placed in an engine compartment of an automobile.

An air duct system 14 of an air-conditioning apparatus is usually located below a dashboard panel within a passenger compartment of an automobile. A fan 15 was provided on one end. On an upstream side (inlet side) of this fan 15, a known inside-outside air switch box (not shown in the figure) which contains a switch to bring in inside or outside air was provided. On a downstream side of fan 15, the above evaporator 12 was located. A thermal sensor which consisted of a thermistor was provided at an air outlet part of the evaporator. Above auxiliary chiller 8 was located next to and at an upstream of heater core 17 which used cooling water for the automobile engine as a heat source. A bypass 18 was formed beside both 8 and 17. A thermal control dumper 19 was used to adjust a flow rate ratio between heated air A which passed through auxiliary chiller 8 and heater core 17 and chilled air B which passed through bypass 18, thereby controlling the temperature of air blowing into a passenger compartment. It can be operated either manually or automatically. After heated air A and chilled air B were mixed and became air with a suitable temperature, it was blown out through a nozzle which opened and closed by a mode-selecting dumper which is not shown in the figure. Control circuit 20 was to control a temperature of blowing air from the evaporator to a set temperature (for example, 3°C~4°C) by turning electromagnetic clutch 2 on and off according to a detection signal input from the above thermal sensor 16. Reference designator 21 denotes an air-conditioning operation switch, reference designator 22 denotes an ignition switch of the automobile engine and reference designator 23 denotes an electric power battery.

Next, operation of the present example with the above constitution will be explained. When the apparatus controlled a temperature except for maximum cooling or heating, thermal control dumper 19 was operated at a middle position as shown in Fig.1.

Therefore, a part of the chilled air which was chilled by evaporator 12 passed through bypass 18, and the rest of the chilled air passed through auxiliary chiller 8 and heater core 17 and became heated air A. At the downstream, heated air A and chilled air B from bypass 18 were mixed to become air with a suitable temperature.

At this point, using chilled air from evaporator 12, auxiliary chiller 8 cooled down a liquid chilling medium having a high temperature and a high pressure which was sent from liquid reservoir 6, thereby super-cooling the liquid chilling medium. In this case, however, auxiliary chiller 8 could demonstrate a high heat dissipation capacity even if it were a small heat exchanger because chilled air at low temperatures (5°C~10°C) from evaporator 12 was used as its cooling air. Therefore, the refrigerating cycle device operated in cycle as shown in the Mollier chart of Figure 2. The cycle can produce a larger super cooling amount (SC) than in a conventional cycle . As a result, a coefficient of performance improved and a cooling capacity increased. Therefore, when compressor 1 was controlled to intermittently turn on and off by control circuit 20, an operation duration of compressor 1 shortened and an operating rate of compressor 1 decreased. Therefore, when the apparatus controls a temperature, the automobile engine ends up needing to produce less power.

Furthermore, although the above example was described when the present invention was applied to an air-conditioning unit with a serial air mixing method, the same effects could be obtained in an air-conditioning unit with a parallel air mixing method as shown in Figure 3 in which an auxiliary chiller 8 was located at an upstream of a heater core 17. However, in such an example, a cooling effect of auxiliary chiller 8 decreased in comparison to the previous example, because air which was not cooled down by evaporator 12 passed through auxiliary chiller 8. Moreover, although the previous example explained a refrigerating cycle device having a liquid reservoir 6, the present invention could be applied to a refrigerating cycle device without a liquid reservoir 6. In such a case, auxiliary chiller 8 functions as an auxiliary condenser, thereby contributing to improvements in a cooling capacity.

As described above, according to the present invention, an auxiliary chiller is provided at an upper stream of a heater core in an air duct system and cools down a liquid chilling medium in a high pressure side and of an upper stream of a pressure reduction

device. Therefore, a sufficient portion of the liquid chilling medium can be super-cooled (SC) or a condensation capacity can be enhanced. As a result, a cooling capacity can be improved and therefore, an operation rate of a compressor is decreased while controlling a temperature. Thus, a large advantage is obtained in that more efficient power-saving can be achieved.

4. Brief explanation of drawings

Figure 1. is a drawing of outline components which describes an example of the present invention. Figure 2 is a Mollier chart related to the operational explanation of the present invention. Figure 3 is a drawing of outline components which describes other examples of the present invention.

1 · Compressor, 4 ··Condenser, 6 ··Liquid reservoir, 8 ··Auxiliary chiller, 10 ··Expansion valve making up of a pressure reduction device, 14 ···Air duct system, 17 ···heater core

Agent Patent Attorney: Takashi Okabe

Figure 1

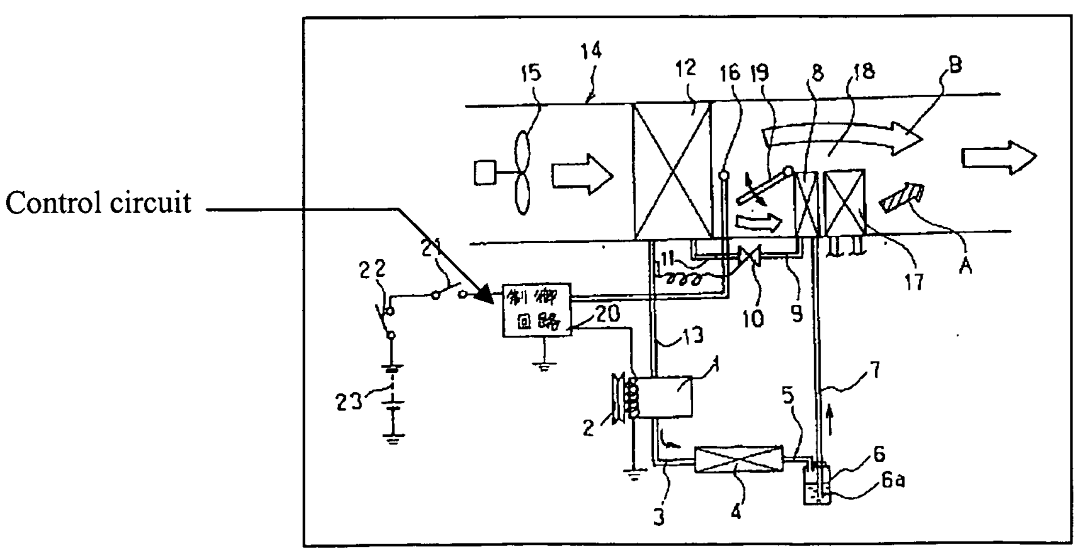
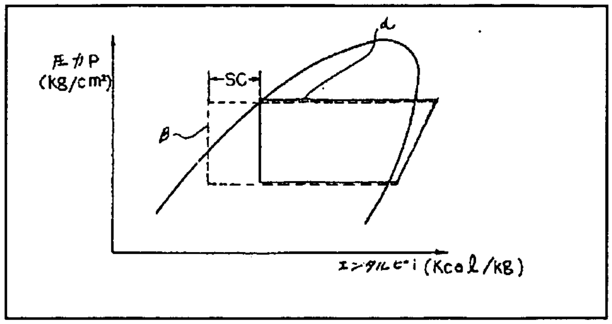


Figure 2

Pressure P

(Kg/cm2)



Enthalpy (Kcal/kg)

Figure 3